

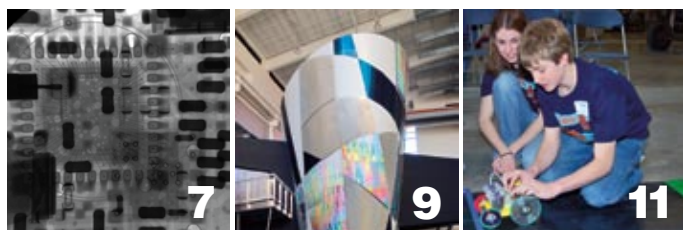
A close-up photograph of a man with a beard and safety glasses, wearing a red plaid shirt, working on a large metal plate. He is using a yellow tool to work on a small hole in the metal. The background is slightly blurred, showing industrial equipment.

IPRT

ANNUAL REPORT 2007

IOWA STATE UNIVERSITY
Institute for Physical Research and Technology

IPRT
works
for Iowa



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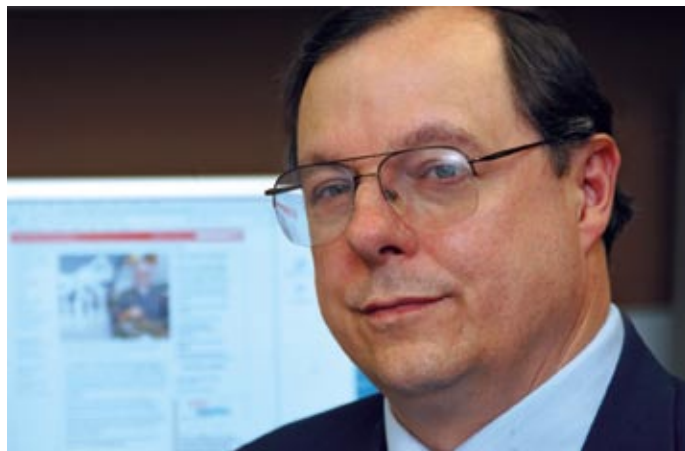
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Cover: Paul Berge, a metallurgist in IPRT Company Assistance's materials group, inspects a weld. Berge was recently certified as a welding inspector and is using these skills to help Iowa companies. Read more in the article on page 6.



It's been a busy nine months since I first became director of the Institute for Physical Research and Technology in July 2007. I'm continually astounded by the depth, breadth and excellence of this organization, be it in our research centers, company assistance programs or educational efforts.

IPRT
works
for Iowa

Scientific research at our IPRT centers has never been more active. With a focus on interdisciplinary efforts, our scientists and staff work on complex problems of vital concern to our state and nation. We also continue to invest in facilities and equipment to maintain our worldwide reputation.

Our Company Assistance arm continues to work with all types of Iowa companies from all corners of the state, focusing solely on serving their needs. Indeed, our staff members have all worked in industry and have a total of more than 57 years of experience in working with companies through IPRT. You can rest assured we understand the needs and demands of industrial partners and clients.

Of course, a vital part of our mission here at IPRT is to educate tomorrow's scientists and engineers and to interest students in science and technology in general. We help middle and high school students through our Science Bound program and our sponsorship of the Ames Laboratory/Iowa State University Science Bowls, while many ISU undergraduate, graduate and postdoctoral students work on IPRT research projects.

In this report, we've highlighted a handful of our research, company assistance and educational efforts. We can't begin to cover all of what IPRT does in a few pages, so I encourage you to check our Web site at www.iprt.iastate.edu to keep abreast of all we're doing.

IPRT works for Iowa. If we can work for you, please contact us.

George Kraus
IPRT Director

IPRT works for Iowa

⊙ In fiscal year 2006-2007, the Institute for Physical Research and Technology had over 170 interactions with more than 120 organizations in 61 Iowa cities and towns. An "interaction" ranges from initial contact and referral to full research projects. While the majority of interactions were handled by IPRT Company Assistance, IPRT's research centers also sometimes work with Iowa companies and other organizations directly.



BETTER SORTING WITH NDE
Muscatine - Tire Environmental

CLEANING UP WASTEWATER
Ames - Siemens Water Technologies Corp.

THE POWER OF MATERIALS
Sioux Center - Groschopp, Inc.

CLEANING UP WASTEWATER

IPRT Company Assistance helped organize and fund a project that looked at ways to reduce nitrogen in wastewater in an economical manner for cash-strapped wastewater treatment plants. The work was done with Siemens Water Technologies Inc. of Ames, Iowa, and an Iowa State University researcher. IPRT's part of the project was led by Kim Bentley, program lead in IPRT's Technology Commercialization Group.

Rohan Wikramanayake, director of process technology of General Filter and Microfloc products at Siemens Water, says his company came to Iowa State for technical expertise and laboratory assistance. Say Kee Ong, a professor of environmental engineering at Iowa State, was the principal investigator. The technology was pilot tested at a municipal plant for the City of Boone, Iowa.

The process uses an existing filter to promote biological growth to enhance denitrification. Nitrates are converted to nitrogen gas biologically with the use of a carbon source as the substrate. Initial results show that the process removes more than 200 pounds of nitrates per cubic foot of media per day, reducing total nitrogen to well below 3 milligrams/liter, which is the most stringent regulatory limit in the United States.

Wikramanayake and Ong co-authored and presented a paper on the effort at a prestigious conference held in San Diego, Calif. Siemens will soon be implementing the technology on a full-scale installation.

Both Wikramanayake and Ong cite the help of Bentley as being essential to the project. "She got the project moving fast and got me to the right people and helped complete the paperwork," says Wikramanayake. Ong adds, "Without her assistance and working with Siemens, it would not have been possible to develop this collaboration."

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Rohan Wikramanayake of Siemens Water Technologies Corp. in Ames inspects new filtration technology being tested at the City of Boone's municipal water plant.

Editor's Note: Kim Bentley has recently left IPRT after 12 years to work for the Iowa Department of Economic Development. We wish her all the best.

THE POWER OF MATERIALS

Groschopp Inc. of Sioux Center, Iowa, engineers and manufactures custom, high-reliability fractional horsepower electric motors and gear motors for some of the world's most demanding "Original Equipment Manufacturers." On several occasions, the company has turned to IPRT Company Assistance to help it maintain its reputation for products of the highest quality.

One project involved a critical spring in a small electric motor. The stainless steel spring was breaking during operation. Based on preliminary analysis, Loren Kamstra, an engineer at Groschopp, suspected that the cause was chlorine used in a lubricant by the spring supplier. He came to Paul Berge, a metallurgist in IPRT Company Assistance, to confirm the analysis and find a solution.

Berge enlisted the assistance of Warren Straszheim of the Materials Analysis and Research Laboratory, part of the Materials Science and Engineering Department at Iowa State University. Straszheim's analysis confirmed that the springs did indeed show signs of chloride residue. The team analyzed a number of other samples to see if Groschopp could do anything to reduce the chlorine since its supplier was unwilling to do so. The samples all showed signs of chlorine, so Berge worked with Kamstra to specify an alloy material more resistant to chloride cracking. Although the new alloy was more expensive, this solution ensured that the springs would not break.

"For the spring investigation alone, we saved around \$5,000 per reported breakage," says Kamstra. He adds that Groschopp was impressed with how quickly IPRT was able to turn the project around. "Our customer was also very appreciative of all the work IPRT did. They're in the automotive industry, so to impress them says a lot," he adds.

Berge and Rick Lopez, another IPRT scientist, also visited the company to share general advice on materials selection and nondestructive evaluation technologies. "We learned a lot from the IPRT scientists, which has led us to change the material on a lot of the shafts we heat treat," Kamstra says. Feldhacker adds, "We now know we have resources available for questions or testing we may need help with."

IPRT WORKS FOR IOWA



Broken shafts in a gearbox assembly made by Groschopp could result in failures of automated doors, golf ball washers, fluid pumps and many other applications. When the company discovered that the shaft was breaking during testing, it turned to IPRT's materials experts for assistance, who helped determine the cause of the broken shaft and propose a solution.

BETTER SORTING WITH NDE

Tire Environmental of Muscatine, Iowa, makes products from recycled shredded tires. The company was exploring additional markets for its products and came to Paul Gormley of Iowa State University's Center for Industrial Research and Service for assistance.

One project involved the problem of removing exposed wire from pieces of shredded tires so that it could be used as landscape mulch. While Tire Environmental had been using magnetic separation to screen out most of the shredded tire bits that contained exposed wire strands, the company had to use a time-consuming and costly visual inspection process to detect the final entrapped steel. Without a considerable leap in capabilities, the company would not be able to scale up to make the venture profitable.

So, Gormley asked Dave Utrata, manager of IPRT's nondestructive evaluation group, to review the company's separation process. As some of the pragmatic aspects of the inspection were beyond the specialty of the group, IPRT invited Industrial Motion Technologies of West Des Moines, Iowa, who represented Eriez Magnetics, a firm that specializes in magnetic separation, to get involved. This company reviewed the metal detection process at Tire Environmental and made suggestions for improvement.

Meanwhile, IPRT's NDE group verified the use of X-ray inspection to reliably detect wires trapped in batches of shredded tires. While this testing was not anticipated to be practical in the field, it helped the team validate proposed alternate sorting methods. As a result of the collaboration, Tire Environmental has significantly improved sorting capabilities with verified quality. "Since we finished the NDE project, the quality of our product has changed so much for the better," says Dennis Froehlich, company general manager, "No one else in the industry seemed to have the answers for me, I am just so glad that Dave and his team were able to help us with this tough problem."

IPRT WORKS FOR IOWA



IPRT's nondestructive evaluation experts helped Tire Environmental of Muscatine create a better process for removing wire strands from shredded tires, making a product suitable for mulch and other applications.

IPRT works for Iowa

Ames

Advanced Structural Imaging
Ag Leader Technology, Inc.
City of Ames
Clearsighted
Frontline Bioenergy
Hach Co.
Hawkeye Renewable
Integrated Sensor Technology
Iowa Energy Center
iPrism

Maxwell Research Corp.
Molecular Express, Inc.
MSTRS Technologies, Inc.
NDE Technologies
PHD Technologies, LLC
Sauer Danfoss Co.
Siemens Water Technologies Corp.
Steve Kartenheuser (Individual)

Ankeny

Des Moines Area Community College
Iowa Association of Municipal Utilities
Iowa Division of Criminal Investigation
(DMACC)
Iowa Division of Criminal Investigation Crime
Laboratory

Atlantic

MAHLE Engine Components USA, Inc.

Bettendorf

Bettendorf Police Dept.

Blairsburg

Chamness Technology

Boone

PowerFilm

Burlington

Case New Holland

Cedar Rapids

Cedar Rapids Police Dept.
Diamond V Mills, Inc.
General Mills, Inc.
Iowa Fluid Power, Inc.
Rockwell Collins, Inc.

Chariton

Johnson Manufacturing Co.

Charles City

Diversified Fastening Systems

Clarinda

NSK-AKS Precision Ball Co.

Clear Lake

Clear Lake Specialty Products
Larson Manufacturing Co.

Clive

Iowa Digestive Disease Center

Council Bluffs

Council Bluffs Police Dept.
CRC

Creston

Bunn-O-Matic Corp.

Davenport

Cocoon Corp.
Davenport Police Dept.
Grace Engineered Products
Hansaloy Corp.
John Deere Davenport Works
Sears Manufacturing Co.

Decorah

Deco Products Co.

Des Moines

CMT, Inc.
Dee Zee, Inc.
Des Moines Police Dept.
Hallett Materials Co.
Iowa Farm Bureau
John Deere Des Moines Works
Principal Financial Group
Wells Fargo

Dewitt

Magnaflux

Dubuque

Weitz Sign

Durant

Schumacher Co., LLC

Eddyville

Ajinomoto

Elkader

E-Ject Systems Engineering
Reference, LLC

Ellsworth

Safe Soy, LLC

Fort Dodge

Josephson Manufacturing Co.

Garner

Suntron of Iowa

Hampton

Hampton Hydraulics
Seabee Corp.

Harlan

Jacobs Corp.

Holstein

V-T Industries, Inc.

Humboldt

Dodgen Industries

Huxley

Kreg Tool Co.

Iowa City

BIOVA
Cellular Engineering
Midwest Forestry and Biofuels
Oral B Laboratories

Jefferson

American Athletic, Inc.

Knoxville

Lee McClune, Sorganol Start-up

Lamoni

Industrial Hardfacing

Maquoketa

Precision Pulley & Idler

Marion

Marion Mixers

Marshalltown

Mechdyne
TIG Distributing

Mason City

Metalcraft

Muscatine

Grain Processing Corp.
HNI Technologies, Inc.
McKee Button Co.
Northern Filter Media
Tire Environmental Services, Inc.

Nevada

ALMACO
Mid-America Manufacturing, Inc.

New Hampton

TriMark Corp.

Oakland

Iowa Fittings Co.

Orange City

Quatro Composites
Silent Drive, Inc.

Oskaloosa

Clow Valve Co.

Pella

Pella Corp.
Vermeer Manufacturing Co.

Perry

Wiese Corp.

Postville

Norplex - Micarta

Princeton

Johnson Manufacturing, Inc.

Ralston

West Central Cooperative

Sidney

Sidney Manufacturing

Sioux Center

Groschopp, Inc.

Sioux City

GELITA North America
Nutra-Flo
Sioux City Police Dept.
Wilson Trailer Co.

Story City

American Packaging Corp.

Sully

Co-Line Welding, Inc.

Urbandale

John Deere Worldwide Agricultural
Equipment Division

Washington

Hays Water Science

Waterloo

Deere & Co.
Engineered Products Co.
John Deere Waterloo Foundry
John Deere Waterloo Works
Waterloo Police Dept.

Waverly

Rada Manufacturing Co.
United Equipment Accessories, Inc.

Webster City

Electrolux Home Products

West Bend

BioMassters Energy, Inc.

West Des Moines

Cellencor, Inc.
Ten Square Global, Inc.

MATERIALS

Metallurgists in IPRT Company Assistance help Iowa companies overcome difficult materials challenges.

Materials lie at the heart of all manufactured products and the processes used to make them. So when a materials problem arises, it's critical to solve it as quickly and efficiently as possible. In these situations, Iowa manufacturers have an edge on their competitors as they have access to the expertise and specialized equipment provided by the materials group within IPRT Company Assistance.

The group provides materials-related services for non-routine problems to Iowa companies. Now in its 15th year of helping Iowa companies, the metallurgists are intimately familiar with the problems faced by today's manufacturers.

"We pride ourselves on providing Iowa companies with easy access to the vast materials resources available at IPRT as well as Iowa State and the Ames

Laboratory," says Tom Lograsso, program manager. Recognizing that many materials problems involve sensitive company information, the interactions are held in strict confidence.

The group's expertise covers the gamut of materials-related topics. The metallurgists can assist with heat treating, corrosion and product integrity issues as well as those in fabrication, cleaning, finishing and coatings. They can help with materials identification, selection and verification. The group can answer questions and provide information about alternative or innovative materials and processing in addition to those about welding, brazing, soldering and mechanical testing. They can also guide companies to additional resources throughout Iowa State and the Ames Lab.

IPRT WORKS FOR IOWA

EXPERIENCE THAT MATTERS

IPRT's materials group has two primary staff members: Tom Lograsso, manager, and Paul Berge, metallurgist.

Lograsso has been the manager of the group since its founding in 1993. He was recently named program director of the Ames Laboratory's Materials and Engineering Physics Program, where he directs research efforts that seek to further fundamental understanding of materials phenomena. The Ames Lab is one of the world's premier research institutions in the materials sciences. Lograsso is also associated with the Materials Preparation Center and has served as a senior metallurgist at the Ames Lab since 1995. He is a member of the Materials Research Society and The Minerals, Metals & Materials Society (TMS).

Berge has been with IPRT Company Assistance for 14 years and has assisted hundreds of manufacturers during that time. With a B.S. in metallurgical engineering and an M.S. in metallurgy from Iowa State University, Berge is also a member of the American Society of Metals International and the American Welding Society.

Contact IPRT's Materials Group

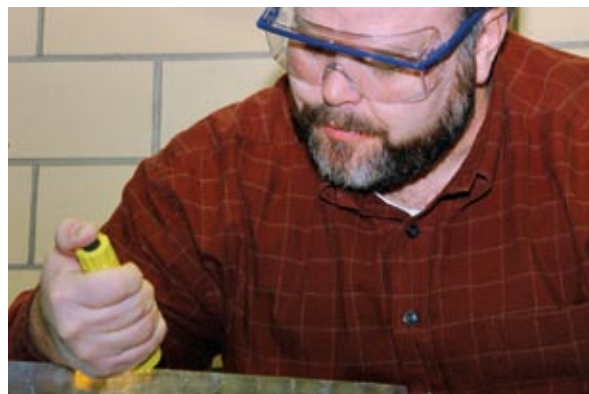
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NEW AT IPRT

CERTIFIED WELDING INSPECTOR IMPROVES IPRT SERVICE

More and more often, Iowa companies are coming to IPRT Company Assistance for insight into welding processes and problems. To better serve these clients, Paul Berge, a metallurgist in IPRT's materials group, has been certified as a welding inspector by the American Welding Society. Berge says his certification will be useful in helping Iowa companies. "I'm able to use the knowledge I gained in the course work to better evaluate a company's welding program and procedures."

Berge attended a six-day course that included a structural steel welding code clinic and a weld inspection technology and visual inspection workshop.



Paul Berge, a metallurgist in IPRT Company Assistance's materials group, inspects a weld. Berge's certification as a welding inspector means that he's able to provide better assistance to Iowa companies with projects that involve welding.

NONDESTRUCTIVE EVALUATION

The nondestructive evaluation experts in IPRT Company Assistance aim to turn Iowa manufacturers into educated consumers of NDE products and services.

◆ Nondestructive evaluation is a collection of powerful technologies to help manufacturers achieve high product quality. Using methods such as X-ray and ultrasound, NDE can spot flaws that are otherwise unseen. As its name implies, NDE is done without destroying the sample, and as a result, the technology can be used to inspect every part or component, if necessary.

Iowa manufacturers have a leg up when it comes to learning about NDE and applying it to their quality challenges. IPRT's Center for Nondestructive Evaluation has been setting the pace for the NDE research for over 25 years. This expertise is made readily available to Iowa manufacturers through the NDE group within IPRT Company Assistance. "We understand how NDE can

be applied in the real world of manufacturing and have been helping Iowa manufacturers do just that for 18 years," says Dave Utrata, program manager.

The group provides a variety of services related to NDE inspection and quality control. Their experts can explain and demonstrate the principles of various inspection methods. They can perform feasibility studies to determine if NDE methods will work for an application and can provide information on sources of equipment, testing laboratories and NDE advances. If more assistance is needed, IPRT's NDE scientists can develop and evaluate inspection procedures for old and new designs or recommend new techniques.

IPRT WORKS FOR IOWA

EXPERIENCE THAT MATTERS

IPRT's nondestructive evaluation program was formed in 1990. The group's primary staff members are Dave Utrata, program manager, and Rick Lopez, a metallurgical engineer. Both Utrata and Lopez do NDE research as well.

Utrata has been with IPRT's NDE group for 14 years. He has both B.S. and M.S. degrees in metallurgical engineering. Utrata has also worked as a research engineer for the Association of American Railroads and is interested in enhancing NDE for non-traditional industries.

Lopez has been at IPRT for eight years. He has an A.A.S. degree in nondestructive testing, a B.S. in metallurgical engineering and is working towards a M.S. in materials science. His industry experience includes work as a manufacturing quality engineer and as an ASME-certified welder and quality control technician.

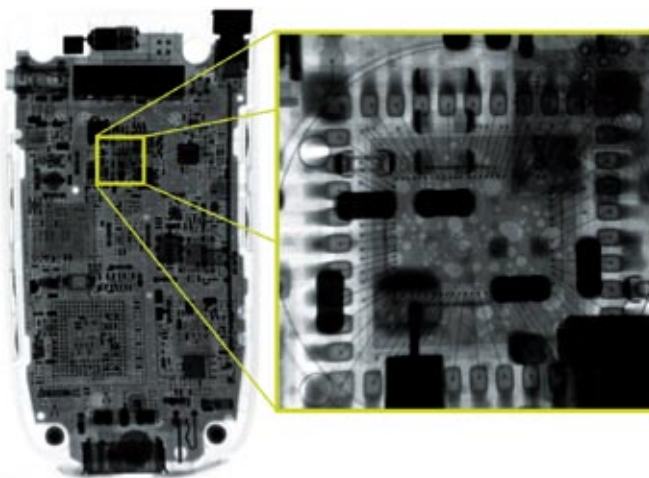
Utrata and Lopez spend part of their time meeting with Iowa manufacturers, both individually and in groups, to educate them about NDE. They review the different stages of manufacturing in which NDE could be used and highlight successful NDE applications in manufacturing. In addition, the group offers a one- to four-hour seminar that provides continuing education credit for industrial attendees.

Contact IPRT's NDE Group

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NEW AT IPRT

NDE Group Adds New X-ray Capabilities



The IPRT Company Assistance NDE group recently upgraded its X-ray capabilities through the purchase of a new microfocus tube that has much finer resolution capabilities. As a demonstration, a cell phone was inspected at the highest magnification allowed using the old tube while still maintaining good image quality (left). The new tube allows for much higher magnification of the phone's internal components while maintaining excellent resolution. An image captured using the new tube (right) shows fine details, such as porosity and wire bonds, that weren't previously visible.

TECHNOLOGY COMMERCIALIZATION

IPRT's technology commercialization associates address product and process development projects and industrial technical problems and work to accelerate commercialization of technology.

☐ For many challenges faced by Iowa companies, there's a researcher at Iowa State University who can help. But how do you find these experts? How do you ensure that the project meets its goals? How do you pay the researchers? The answers can be found in the Technology Commercialization Group within IPRT Company Assistance. This staff of professionals develops and manages collaborative projects between Iowa State researchers and Iowa companies. Each year, the group sets up about 25 such projects.

"The uniqueness of our group is its focus on the needs of Iowa companies, providing problem solving,

product development and process improvement," says Lynne Mumm, technology commercialization associate. The group has funds to share the cost of research, with a maximum of \$15,000 per project. But its focus is on developing and managing projects. The associates can assemble a research team, lead meetings and monitor projects to meet goals and deadlines. This team also works to prepare technologies for commercialization or to be further developed with industry. These efforts range from seed funding research to working with Iowa State researchers.

IPRT WORKS FOR IOWA

NEW AT IPRT

Sowing Seeds for Economic Development

IPRT's Technology Commercialization group has awarded nearly \$95,000 to five early-stage research projects. The funds will support preliminary research on Iowa State innovations with potential to foster economic development in Iowa. The projects are sponsored through funds provided to IPRT Company Assistance from the "Grow Iowa Values Fund," a state economic-development program. Each project also includes matching funds from the research group or industry partner.

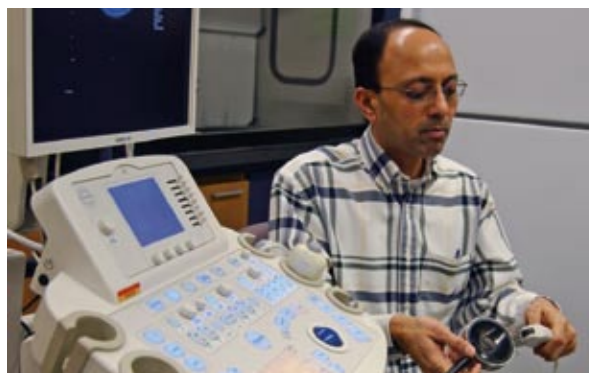
"These seed grants will help projects get to a stage where further funding is much more likely," IPRT director George Kraus says. Moreover, the grants are made with an eye for commercial potential. The projects include:

- Methods to make window frames from agricultural oils, with Michael Kessler, professor of materials science and engineering, and Richard Larock, Distinguished Professor of chemistry and a scientist in IPRT's Center for Catalysis.
- Technology to protect privacy in location-based services, such as text-based messaging on cell phones, with Ying Cai, professor of computer science.

EXPERIENCE THAT MATTERS

IPRT's Technology Commercialization Group staff includes Lynne Mumm and Brian Muff. Mumm has been with IPRT for five years and spent eight years at the ISU Research Foundation. She has an MBA as well as a B.S. in science. Muff has three years of experience at IPRT. He worked for three years as a chemist and three years in product management/marketing. Muff has an MBA as well as a B.S. in chemistry.

- Ultrasound technology to improve tissue characterization, with Viren Amin and Bruce Thompson, both scientists in IPRT's Center for Nondestructive Evaluation.
- A new generation of flow meters for testing diesel engines, with Michael Olsen, professor of mechanical engineering, and Hui Hu, professor of aerospace engineering.
- Technology that uses recycled tire products to scrub air and waste treatment gases to remove hydrogen sulfide, with Timothy Ellis, professor of civil, construction and environmental engineering.



Viren Amin, a scientist with IPRT's Center for Nondestructive Evaluation, explains development of new ultrasound technology aimed at improving tissue characterization.

Contact IPRT's Technology Commercialization Group

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VIRTUAL REALITY AT ITS BEST

IPRT's Virtual Reality Applications Center upgrades its venerable C6 virtual reality system, once again making it the leading facility of its kind anywhere in the world.

►The Virtual Reality Applications Center's C6 virtual reality room first opened in 2000 and quickly became the standard by which such systems are judged throughout the world. It was the country's first wireless, six-sided virtual reality room designed to immerse users in images and sound. And now, after nearly \$5 million in upgrades completed in 2007, the new C6 is once again a world leader. It now projects more than twice the resolution produced by any other virtual reality room in the world — 16 times the pixels produced by the original C6.

The difference between the original equipment and the updated technology "is like putting on your glasses in the morning," said James Oliver, VRAC director. Oliver is leading a research team that uses the C6 to develop

a control interface for the military's next generation of unmanned aerial vehicles. The researchers are building a virtual environment that allows operators to see the vehicles, the surrounding airspace, the terrain they are flying over as well as information from instruments, cameras, radar and weapons systems. The system allows a single operator to control many vehicles.

Researchers are also using the C6 to visualize data from as many as 22,000 genes to train soldiers for urban combat, to show students how plant photosynthesis works and to help engineers visualize new products.

The new equipment was installed by the Mechdyne Corp. of Marshalltown, Iowa, and is supported by the U.S. Air Force Research Laboratory.

IPRT WORKS FOR IOWA



With more than 100 million pixels of display space, VRAC's upgraded C6 (exterior view, right) is up to demanding research, such as developing control interfaces for the military's next generation of unmanned aerial vehicles (left).

ON TOP OF THE WORLD

Record-breaking Resolution

The C6's 100 million pixels spread across 600 square feet and six surfaces make it the highest resolution immersive environment in the world, shattering the old record.

Largest Graphics Cluster

Some 16 million pixels per wall are generated by a 48-node, 96-channel workstation cluster — the largest of its kind in the world.

Highest Quality Stereo 3D

Mechdyne's proprietary Beacon shuttering technology switches 80 times/second between left and right eye

images (160Hz), enabling the human brain to perceive incredibly sharp, depth-enhanced images.

Improved Interaction

New ultrasonic position tracking provides better and more natural wireless communication between users and applications.

Innovative Imaging

Mechdyne developed an optical blending solution to blend the images from two projectors for each wall.

Realistic Sound

The upgraded 8.1 channel sound system supports 3D audio to create an even more realistic immersive experience for the user.

GOOD VIBRATIONS DETECT BAD LEAKS

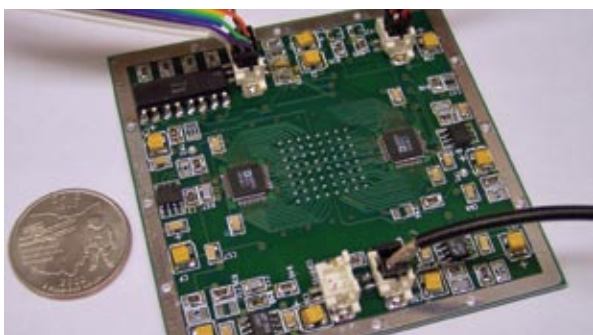
Scientists at IPRT's Center for Nondestructive Evaluation are working with NASA to develop new methods of detecting air leaks in spacecraft.

◆ Tiny meteors and spacecraft debris — objects just a few millimeters in size — can pierce the thin aluminum skin of a spacecraft, causing a small leak of pressurized air. “NASA wants to be able to find these leaks,” says Dale Chimenti, a researcher with IPRT’s Center for Nondestructive Evaluation and an Iowa State University professor of aerospace engineering. “Fixing them is easy. But the question is, ‘Where is the leak?’”

Leaks are hard to find because spacecraft are full of life-support systems, computers, controls, gear and research equipment. All those things can hide a leak. Leaks are also hard to find because astronauts can’t hear the telltale hiss of escaping air. That hiss is blowing outside the spacecraft and away from searching ears. “Astronauts had better find that leak as quickly as they can,” Chimenti explains. A spacecraft can only produce so much oxygen. NASA can’t afford for it to slowly and steadily blow into the cold vacuum of space.

And so NASA asked researchers led by Chimenti to develop a sensor that can find leaks by detecting the small vibrations in the metal skin of the spacecraft caused by escaping air. NASA has so far supported the work with \$600,000 over four years. NASA has recently funded Invocon and ISU to continue this work under a Phase II STTR, worth another \$600,000. The Iowa State engineers are working with Invocon Inc. of Conroe, Texas, to use their sensor with the company’s wireless electronics.

Chimenti’s research team includes Stephen Holland, an assistant professor of aerospace engineering; Ronald Roberts, a scientist at CNDE; Ricky Reusser, a recent Iowa State graduate who earned his bachelor’s degree in aerospace engineering; and Steven Sulhoff, a senior in aerospace engineering from Avoca, Iowa.



This tiny sensor, consisting of a custom circuit board with a piezoelectric array, pre-amps and multiplexers, detects vibrations caused by leaking air, helping to pinpoint air leaks in the metal skin of manned spacecraft. The technology is being developed by researchers from IPRT’s Center for Nondestructive Evaluation.

The researchers developed a square sensor that’s an inch across and includes an array of 64 elements. These elements determine the direction from which the vibrations come. The set of directions observed at the different transducer positions are then analyzed by a computer to determine the location of the leak. A leak can be found in about a minute versus days or even weeks to find a leak with NASA’s current handheld, ultrasonic detection devices.

But it wasn’t easy to improve the technology. Chimenti says a major challenge was accounting for a reinforcing grid that rises from the back of a spacecraft’s shell and affects the travel of vibrations. The researchers solved the puzzle by targeting the frequency range measured by the sensors. They focus on lower frequencies and that reduces the effects of the reinforcing grid.

If NASA funds a follow-up proposal, the researchers would develop a prototype of the leak-detection system for NASA. “This project has gone very well,” Chimenti says. “We have developed a highly sophisticated array sensor, along with the electronics, that can be fabricated at low cost. Despite the challenge of locating an extremely weak random noise source, our system is both robust and reliable.”

IPRT WORKS FOR IOWA

BIO-FUELS BYPRODUCT ENHANCES SOIL

Researchers from IPRT’s Center for Sustainable Environmental Technologies are leaders in converting farm wastes, such as corn stalks, into bio-fuels. The technology is becoming even more attractive, however, as the scientists research the benefits of using charcoal byproducts of the process as a soil additive. Incorporated into the soil, scientists believe this “bio-char” helps soil retain beneficial nutrients and microorganisms. What’s more, because charcoal is stable in the soil, the process can help sequester carbon, a major goal in the quest to reduce global warming.

CSET researchers are working with Harry Stine, president of Stine Seed Co. of Adel, Iowa, to further study the use of bio-char as a soil additive, looking at application rates and resulting crop production. Although Stine’s test farm is in South America, Stine believes soils here in the Midwest can also benefit. “We believe the multiple benefits of developing bio-fuel and bio-char from corn stover or other similar materials are tremendous,” he says.

IPRT WORKS FOR IOWA

SCIENCE BOUND REACHES MORE STUDENTS

Science Bound is not just for Des Moines students anymore! The educational program for students in grades eight through 12 is now serving students in Denison and Marshalltown, Iowa.

In Denison, Smithfield Foods, Inc. is partnering with the Science Bound program through Learners to Leaders, Smithfield's national educational alliance. The program will run from October 2007 to May 2012, and the estimated \$256,000 cost for the five years will be funded by Smithfield Foods. The Marshalltown Science Bound program is being funded in part by the Martha Ellen Tye Foundation and Fisher Controls, Inc. from 2007 to 2011. The pilot program was funded by NASA.

Managed by IPRT, Science Bound is Iowa State University's premiere program to equip and empower diverse Iowa students to earn degrees and pursue careers in science, technology, engineering and mathematics. To date, more than 200 students have graduated from the Des Moines pre-college program; thirty eight are currently attending Iowa State University and 49 have graduated with degrees from ISU.

SCIENCE BOWL PUTS FUN INTO SCIENCE

Young scientists and mathematicians from all across Iowa met on Iowa State University's campus to compete in the annual Ames Laboratory/ISU High School and Middle School Regional Science Bowls. In addition to being a major sponsor, IPRT had many employees volunteer at the competitions.

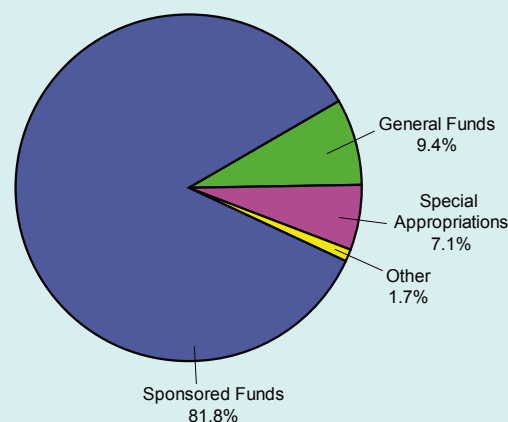
The High School Regional Science Bowl was held in January 2007 and involved 48 four-player teams. The students went head-to-head in fast-paced, question-and-answer matches over topics like earth science, physics, astronomy and math. Defending champion Regina High School of Iowa City finished first and went on to compete in the National Science Bowl in Washington, D.C. There, they placed third in the Hydrogen Fuel-cell Model Car challenge, earning \$1,250 for their high school.

The Middle School Regional Science Bowl took place in April 2007, and 16 teams made and raced hydrogen fuel-cell cars and competed in a quiz bowl. Central Academy of Des Moines came out on top. At the National Middle School Science Bowl in Denver, Colo., they placed sixth and won \$500 for their school.

IPRT FUNDING SOURCES

In fiscal year 2006-2007, IPRT programs and projects received funding totaling \$25.3 million. Federal, industrial and state research contracts composed 81.8 percent of IPRT's funding, ISU general funds contributed 9.4 percent, state special appropriations provided 7.1 percent, and 1.7 percent came from other sources.

More than 750 faculty, professional, clerical and student employees serve the Institute for Physical Research and Technology. Almost one-third of IPRT's staff is composed of Iowa State University graduate and undergraduate students who contribute to IPRT's excellence while seeking degrees.



A SUMMER OF INTERACTION



Shaleta Bennett (left), a sophomore from Jackson State University, describes her research on a virtual battle space project. Bennett was a student in the 2007 Summer Program for Interdisciplinary Research and Education – Emerging Interface Technologies (SPIRE-EIT), a ten-week undergraduate internship. The students work collaboratively in interdisciplinary teams, receive core training and gain hands-on research experience with emerging interface technologies. The program is run by IPRT's Virtual Reality Applications Center.

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IOWA STATE UNIVERSITY

Institute for Physical Research and Technology

IPRT is a network of scientific research centers at Iowa State University, specializing in world-class fundamental and applied interdisciplinary research in physical sciences and engineering. IPRT also helps Iowa companies solve technical problems, create new products and increase productivity and quality through its Company Assistance programs. IPRT's educational programs foster interest in science and technology and help educate tomorrow's engineers and scientists.

RESEARCH CENTERS

Catron Center for Solar Energy Research

Supports research on solar energy technologies that can address national energy needs.

Center for Building Energy Research

Focuses on efficient and renewable energy issues related to buildings and developing technologies to reduce energy consumption while maintaining performance and productivity.

Center for Catalysis

Dedicated to the development of useful, practical catalysts and sustainable green chemistry methods. Scientists investigate the application of catalysis and green chemistry methods to agricultural, industrial and environmental science.

Center for Nondestructive Evaluation

Develops noninvasive methods and instruments for assessing the integrity of structures and materials.

Center for Physical and Computational Mathematics

Researches high-performance computing via cluster computing and parallel computing strategies.

Center for Sustainable Environmental Technologies

Develops and demonstrates renewable energy and chemical technologies and environmental technologies related to fossil fuels.

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Identifies and provides solutions for national aircraft safety problems with a focus on inspection and maintenance issues. Major efforts include the Center for Aviation Systems Reliability and the Engine Titanium Consortium.

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Enables fundamental research in a wide array of scientific disciplines by synthesizing high-purity metals, alloys and compounds in well-controlled purity, specified physical form and desired microstructure. Key capabilities include synthesis and crystal growth of complex alloys, processing of high-purity rare earth metals and alloys, and synthesis of high purity metallic powders.

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Partners with local, state and federal agencies to address regional forensics needs for training, research, casework and education.

Virtual Reality Applications Center

Applies virtual reality technology to the challenges of science and engineering.

IPRT COMPANY ASSISTANCE

Leverages IPRT's world-class expertise and equipment to help Iowa manufacturers and entrepreneurs address specific research and development needs. IPRT Company Assistance provides technical assistance, contract research and development, and start-up and technology-commercialization assistance.

EDUCATION

Science Bound

Works to increase the number of diverse Iowa students who pursue science and technology careers.

Student Researchers

About one-third of IPRT's workforce is composed of undergraduate and graduate students who learn by working on real-world research projects.

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